V, and so on. When the pump has made a few strokes in this manner, a lever T is let down, so as to rest on the ledge *u*. The wheel F provided with six pegs is now turned a tooth farther each time the weight C slides from the left to the right, and the ledge-peg *f*, which when the lever was raised caught each time into a notch of the peg-wheel, rests for the length of five strokes of the pump against the circumference of the wheel, and does not catch into the notch until the sixth stroke. As the rising of the quicksilver in the pump is in the inverse proportion of the momentum of the counter-weight in its left final position, if the ledges and peg *f* are rightly placed, it will when ascending be driven five times into the little hollow space r_2 and only at the sixth into the ball *n*. In consequence of this the little air-bubbles are accumulated in the highly evacuated space r_1 in which they ascend owing to the slight counter-pressure, and forming larger bubbles, and having easily overcome the somewhat greater counter-pressure of the mercury column s_1 they rise into the ball P.

All these manipulations are performed *entirely automatically* by the apparatus. At the same time that the toothed wheel has commenced working (*i.e.* when the volume of air pumped out by the pump has sufficiently diminished) the vessel P is entirely cut off from the hydrostatic air-pump by the cock t_1, thus ceasing to act. The mercury of the pump is entirely shut off on *both sides* from the exterior air, and only in contact with perfectly *dry* air. After stopping the pump, concentrated sulphuric acid may be sucked up into P, which dries up entirely. The mercury is shut off from M by a caoutchouc bag, I.

The following experiments were made at the Physical Institute of the University of Berlin:

400 c.cm. (cubic centimetres) were evacuated to 1/1000 m.m. in ten minutes; 4000 c.cm. = 4 litres, in an hour.

The highest rarefaction hitherto obtained has been about from 1/6000,00 – 1/800,000 m.m. = to about $\frac{1}{130000000} - \frac{1}{600000000}$ atmospheres.

The pump is supplied by Messrs. E. Leybolds Nachfolger, Cologne (Germany).

AUGUST RAPS.

CRYSTALLISED CARBON.

IN the course of some researches on the properties and modes of formation of the various forms of carbon, M. Henri Moissan has succeeded in reproducing the variety of diamond known as *carbonado*, or black diamond, and has even obtained some minute crystals of the colourless gem. An account of his results in the *Comptes Rendus* of February 6 is followed by an article on the reproduction of the diamond, by M. Friedel, and some congratulatory remarks by M. Berthelot.

As long ago as 1880 Mr. Hannay[1] indicated the formation of diamond-like crystals on heating under high pressure, in a tube of iron, a mixture of lithium, lamp-black, essence of paraffin, and bone oil. It was then supposed that the nitrogenous compounds of the last substance played the most important part. In M. Moissan's new process carbon obtained from sugar is dissolved in a mass of iron, and allowed to crystallise out under high pressure. To produce this pressure the expansion of iron during condensation is utilised. The carbon is strongly compressed in an iron cylinder closed with a screw-stopper of the same metal. A quantity of soft iron, weighing about 150 or 200 gr., is melted in the electric furnace in a few minutes, and the cylinder is plunged into the molten mass. The crucible is at once taken out of the furnace and splashed over with water. When the external crust is at a red heat the whole is allowed to cool slowly in air.

The metallic mass thus obtained is attacked by boiling hydrochloric acid until all the iron is removed. There remain three forms of carbon: graphite in small quantity; a chestnut-coloured carbon in very small needles, such as has been found in the Cañon Diablo meteorite; and a small quantity of denser carbon which has to be further isolated. For this purpose the mixture is treated alternately with boiling sulphuric and hydrofluoric acids, and the residue decanted in sulphuric acid of density 1·8. It then contains only very little graphite, and various forms of carbon. After six or eight treatments with potassium chlorate and fuming nitric acid, the residue is boiled in hydrofluoric acid and decanted in boiling sulphuric acid to destroy the fluorides. It is then washed and dried, and bromoform is employed to separate out some very small fragments denser than that liquid, which scratch the ruby, and, when heated in oxygen at 1000°, disappear.

Some of these fragments are black, others transparent. The former have a rough surface, and a greyish black tint identical with that of certain carbonadoes; they scratch the ruby, and their density ranges from 3 to 3·5. Some pieces have a smooth surface, a darker colour, and curved edges. The transparent fragments, which appear broken up into small pieces, have a fatty lustre, are highly refractive, and exhibit a certain number of parallel striæ and triangular impressions.

During combustion in a current of oxygen at 1050°, some of the fragments left cinders of an ochreous colour, usually preserving the original form of the small crystal—just as in the combustion of impure diamonds.

As indicated already by Mr. Sidney Marsden,[1] silver heated to 1500° in presence of sugar carbon is found to contain on cooling some black crystals with curved edges. M. Moissan has found that high pressure is indispensable. He heated silver till it boiled briskly in contact with carbon, and found that a certain quantity of the latter was dissolved. By suddenly cooling in water, a portion of liquid silver, cooling inside a solid crust, was subjected to a very high pressure. No diamonds were formed, but rather a large crop of carbonadoes of densities ranging from 2·5 to 3·5, thus forming a series connecting graphite with diamond. Bromoform separated a carbonado, which scratched the ruby and burned in oxygen at 1000°. A quantitative determination of this reaction showed that 0·006 parts of this substance gave 0·023 of carbonic acid.

M. C. Friedel describes an experiment in which he obtained a black powder capable of scratching corundum by the action of sulphur on molten iron containing 4 per cent. of carbon. But the question of the production of diamond powder by this means is as yet an open one.

M. Moissan is continuing his researches on the solubility of carbon in iron, silver, and their alloys. It is to be hoped that he will soon be able to exhibit artificial true diamonds of a more imposing size.

LINES OF STRUCTURE IN THE WINNEBAGO CO. METEORITES AND IN OTHER METEORITES.[2]

THE ground and polished surface of a Winnebago Co. meteorite showed to me some interesting markings. Subsequent examination revealed like markings in other meteorites. Perhaps these markings have been described. If so I have no recollection of the description, and therefore it seems worth while to call attention to them.

The polished surface of a small Winnebago stone, three or four square centimetres in area shows several hundreds of bright metallic points. The larger iron particles in this surface have great varieties of shapes—the smaller

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[1] Proc. Roy. Soc., vol. xxx. p. 188.

[1] Proc. Roy. Soc. Ed. 1880, vol. ii. p. 20.

[2] Reprinted from the February number of the *American Journal of Science*.

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ones are usually mere points. When seen with a lens, or even at a distance from the eye suited to distinct vision there does not appear to be any regular structure or arrangement of the bright points. But if the surface is so held as to be a little beyond the place of distinct vision, and at the same time, turned around in such a way as to reflect always a strong light to the eye, either skylight or lamplight, there appear lines of points across the polished surface of the stone, which suggest very strongly the Widmanstaetten figures on metallic meteorites. At times, as the stone is turned, no lines can be detected. Again one set of parallel lines or two sets crossing each other become visible. Some of the sets are very sharply manifested, and some are so faint as to leave one in doubt whether the lines are real or only fancied. There are on the surface in question six or eight of these sets of lines.

A second surface was ground nearly parallel to the first, at about one centimetre distant from it, and like lines appeared on this parallel surface. Some of the lines, but not all of them, corresponded in direction in the two surfaces. Four more surfaces approximately at right angles to the first surface, and corresponding to the faces of a right prism, were then ground, and upon these surfaces the like sets of lines appear with more or less distinctness.

A slab of a Pultusk stone 6 × 7 centimetres shows over its entire surface like markings. Something like a curvature of the lines appears in one instance, but in general the lines run straight from side to side of the slab. The slab is six millimeters in thickness, and most of the sets of lines have the same directions upon the two sides.

A Hessle stone, a small slice from the Wold Cottage stone, one from Sierra di Chaco, one from a Sienna stone, a fragment from the Rockwood stone, and a slice from the Rensselaer Co. stone, all show with more or less clearness the like markings. Of three microscope slides of the Fayette Co. meteorite one shows them clearly, a second shows traces of them, the third not at all.

A considerable number of the ground surfaces of meteoric stones in the Peabody Museum also show these markings. For example, a triangular surface of a Weston stone, 8 or 10 centimetres to each side, exhibits them very well.

These markings are such as we might expect if the forces which determine the crystallisation of the nickel-iron of the iron meteorites also dominated the structure of the rock-like formations of the stony meteorites and the distribution therein of the iron particles. The relation of quartz crystals to the structure of graphic granite is naturally suggested by these meteorite markings.

H. A. NEWTON.

THE LATE THOMAS DAVIES, F.G.S.

MR. THOMAS DAVIES, who died on December 21 last, was born on December 29, 1837, in the neighbourhood of London, and was the son of Mr. William Davies, F.G.S., of the Geological Department of the British Museum. His early education was of a very elementary character, and the period of his school-life was brief: finding town-life irksome, and yearning for freedom and adventure, he took to the sea at the age of fourteen, and during the next four years led a roving life, visiting China, India, and various parts of South America. He was then prevailed upon by his father to adopt a more settled mode of existence, and on the separation of the Department of Mineralogy from that of Geology was appointed in 1858 a third-class attendant at the British Museum under Prof. Maskelyne, to whom the care of the minerals had been assigned; in the following year he added to his responsibilities by marriage.

During the next nine years, save for a short interval when Dr. Viktor von Lang was an assistant in the Department, Mr. Davies was the sole helper of Mr. Maskelyne in the arrangement and examination of the mineral collections; during this time Mr. Maskelyne effected a thorough change in the classification and arrangement of the minerals, and in labelling with localities the large number of specimens that were without any descriptions except what could be traced out in old catalogues. In this work, and in the cleaning and arranging some tons of specimens, of which many were entirely valueless, the patient and intelligent aid of "young Davies" alone rendered it possible to carry out the preliminary operations. As the collection grew into orderly arrangement, the registration and labelling of specimens was entrusted to him by Mr. Maskelyne. It was thus that he gradually acquired an eye-knowledge of minerals which has rarely, if ever, been surpassed. His perception of the peculiarities of a specimen was remarkably quick, while his remembrance of individual specimens was almost marvellous. It was particularly in the habit, the locality, the associations and modes of occurrence of mineral species that he concentrated his interest; and to his knowledge in this direction his earlier training, under the eye of Mr. Maskelyne, in the labelling of the minerals, accumulated in the cases and drawers of the collection, very largely contributed.

In the early years of Mr. Davies's museum life Mr. Maskelyne was further engaged in the study of thin sections of meteorites, and initiated Mr. Davies into a knowledge of the microscopic characters of rock-forming minerals, a mode of investigation then almost unknown. In this direction his quickness of perception and excellence of memory had full scope for play, and Mr. Davies soon became extremely skilful in the microscopic determination of minerals in rock-sections, and in the recognition of peculiarities of rock-structure. Few practical petrologists approached him in this faculty.

Nor did he neglect to improve his general education. With this end in view he attended the evening classes at the Working Men's College in Great Ormond Street, and in the course of time acquired a knowledge of both French and German. He was also familiar with plants and fossils, a knowledge largely derived from his father.

His remarkable qualifications attracted the early attention of Mr. Maskelyne, and in 1862 were officially recognised in his promotion by the trustees from the grade of attendant to that of transcriber or junior assistant. In 1880 he was promoted to the grade of first-class assistant. By a remarkable coincidence his father, Mr. William Davies, who had long been renowned for his large practical knowledge of important branches of palæontology, and especially of fossil fishes, and had likewise begun museum life as an attendant, obtained the same promotion on the same day. In the same year Mr. Davies was awarded the balance of the proceeds of the Wollaston Fund by the Council of the Geological Society as a testimony of the value of his researches in mineralogy and lithology. Still later, in 1889, the name of *Daviesite* was given to a new mineral "in honour of Mr. Thomas Davies, who has now been associated during upwards of thirty years with the British Museum Mineral Collection, and whose mineralogical experience and Breithauptian eye have ever been willingly placed at the service, not only of his colleagues, but of every one who has been brought into relationship with him."

He became a Fellow of the Geological Society in 1870, and was an early member of the Mineralogical Society of France.

His published work was not voluminous; it relates almost exclusively to the microscopic characters of the pre-Cambrian rocks. He contributed, however, the bulk of the articles on mineralogy and petrology for "Cassell's Encyclopædic Dictionary," and for some years edited the *Mineralogical Magazine*.

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